April 1979

International Political Effects Of the Spread of Nuclear Weapons

Edited by
John Kerry King

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The essays in this publication were written for a colloquium organized to consider the potential international political consequences if the number of states possessing nuclear weapons increases significantly during the next 10 to 15 years.

The colloquium was sponsored by the National Foreign Assessments Center, Central Intelligence Agency, and by the Office of the Assistant Secretary of Defense for International Security Affairs.

The essays are the personal views of the authors. They do not represent official government analysis, the viewpoint of either sponsoring agency, or a consensus of the participants in the colloquium.

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FOREWORD

Technical and economic considerations no longer prevent the acquisition of nuclear weapons by nations that do not have them. The technology is now widely known and generally accessible, and the cost is not prohibitive. For an increasing number of nations a decision to develop nuclear weapons rests on political and strategic factors.

An important, high priority aspect of United States foreign policy is to stop, or to curtail, tendencies toward the spread of nuclear weapons and of weapons-related technology. However optimistic the outlook for that policy—and there are reasons for optimism—the potential consequences of continued proliferation can be very significant and, therefore, are worthy of serious discussion, even though the analysis may include considerable speculation.

A spread of nuclear weapons would appear likely to alter the political interests and attitudes of many nations, and to change, perhaps dramatically, the international political environment in which United States foreign policy would have to function. For example: the number and diversity of countries and situations of strategic concern would be multiplied; the potential destructiveness of relatively limited regional wars would be increased; the requirements for defense, for security, and for alliance strategy would be reviewed by many nations; and fundamental concepts of international relations could be affected.

There is an extensive literature on the scientific and technological aspects of nuclear weapons development, on the relationship between weapons development and nuclear energy, on the economic trade-off between nuclear and other forms of energy, and on various strategies to discourage or to prevent the development of nuclear weapons by, or their spread to, nations that do not have them. Comparatively little research and analysis has been done on the potential political consequences if further nuclear weapons proliferation does in fact happen. Although there are some outstanding exceptions, the literature on the "what if" aspects of the subject is not extensive or comprehensive.

The colloquium for which this series of essays was written was planned as a step toward closing that gap and as a means of stimulating additional work on the subject by government and academic researchers and analysts. The colloquium was unclassified, and it was conceived as a multi-disciplinary, speculative inquiry into the nature and dynamics of international relations in a future world in which the possession of nuclear weapons had spread significantly. The assumed time was about 1995.

Knowledgeable and creative thinkers from differing disciplines and backgrounds were invited to write original essays on various aspects of a future international political scene. All used as their starting point a series of broad assumptions concerning the spread of nuclear weapons, set in the context of several other international issues. The statement of assumptions provided the essayists was as follows:

"The essays prepared for this colloquium and the ensuing discussions are based on the assumption that, despite the best efforts of the United States and other nations, the trend toward the spread of nuclear weapons and nuclear technology will gain momentum during the next decade. Because the nuclear situation cannot stand in isolation, several broad assumptions concerning other significant and likely global developments also are offered. The assumptions are intended as a common starting point and general guide for the essayists and the conference discussion, not foregone conclusions concerning the future nor boundary lines limiting speculation or analysis. Some may want to alter or to add to the assumptions provided, and they are invited to do so.

"The 1980s are likely to be a trying decade for the United States. It appears that the world will become an increasingly complex and stressful setting for the pursuit of United States policy objectives and increasingly resistant to unilateral United States efforts at problem solving. Domestic political weaknesses and economic difficulties in at least half the nations of the world seem likely to exert higher degrees of pressure for short-term, nationalistic responses to urgent resource, economic, and security problems that can be solved, if at all, only by multinational efforts. Frictions between the less developed and the industrial states will probably intensify as global economic problems stimulate the demands of the former and limit the capability or willingness of the latter to respond.

"Four present international issues of special significance are likely to continue to exacerbate national and international political affairs during the 1980s, and they will be sources of increasingly acute tension:

1. The world energy situation probably will be more critical. Fossil fuels will be expensive and in some instances scarce; energy demand will be higher than today, although the rate of increase may slow; and alternate follow-on energy systems will not yet be available.

2. The pressure of expanding population on available food supplies seems certain to intensify. We assume no technological breakthrough with respect to food production, no significant change in the world distribution system, and no sociological turnaround with respect to population control.

3. The gap between the rich and the poor nations, the industrial and the non-industrialized, will widen; however, a small number of the so-called middle tier states are likely to make substantial economic progress.

4. Terrorism will probably intensify and spread. The economic, political, and sociological conditions that spawn it, and the complex psychological motivations that energize it, are not likely to ameliorate during the decade.

"During the decade of the 1990s a large number of nuclear reactors will be in operation around the world. They will be present on all continents, and at least 50 countries will have the capability to develop nuclear weapons. For the purposes of this colloquium, we assume that more than a dozen of them of varying motivations and capabilities will have developed or otherwise acquired a nuclear weapons capability. Many others will be able to do so in a brief period. The following nations are among those likely to have the capability and some degree of motivation to acquire nuclear weapons: Argentina, Brazil, Iran, Israel, Egypt, Iraq, Japan, South Korea, Taiwan, Spain, West Germany, Yugoslavia, India, Pakistan, Libya, South Africa, Greece, and Turkey.

"Despite the spread of nuclear weapons, we assume that a sense of military 'balance' between the United States and the Soviet Union will continue and that their nuclear power will overshadow that of all others."

The colloquium brought together 50 people from the academic, research organization, intelligence, and national security policymaking communities for three days in October 1978, to discuss the essays and the questions generated by them. The emphasis throughout was on attempting to describe and analyze the international political environment under the assumed circumstances. The colloquium plan did not contemplate reaching a consensus on the many issues that emerged or arriving at an agreed set of conclusions. Rather, it was intended to stimulate thought and to assist in planning future research and analysis.

After the colloquium the authors were given a month in which to make any revisions they desired in their manuscripts. The essays stand on their own as the work of the individual authors. They have been published and made available because they may be of general interest and may stimulate further work on the subject.

John Kerry King
Colloquium Coordinator
February 1979
Menlo Park, California

THE DEVELOPMENT AND DEPLOYMENT OF NUCLEAR WEAPONS SYSTEMS IN A PROLIFERATING WORLD

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ABSTRACT

Osric: The King, sir, hath wagered with him six Barbary horses, against which he has imponed, as I take it, six French rapiers and poniards, with their very assigns, as girdle, hanger, and so—three of the carriages, in faith, are very dear to fancy, very responsive to the hilts, most delicate carriages, and of very liberal conceit.

Hamlet: What call you the carriages?

Horatio: I knew he must be edified by the margent * ere you had done.

Osric: The carriages, sir, are the hangers.

Hamlet: The phrase would be more germane to the matter if we could carry a cannon by our sides. I would it might be hangers until then...

Wm. Shakespeare: Hamlet; Act V, scene ii.

The high-flown language of Osric is harmless parody of the courtiers of Shakespeare's time. The difficulties faced by present-day arms control analysts in dealing with persistent oversimplification in description of potential weapons capabilities are more serious. A nuclear explosive is not necessarily usable as a weapon. To perform a military as well as a diplomatic role, a nuclear explosive device must be designed and constructed so that potential users will have confidence in its performance, and mated to a means for delivery to a potential target appropriate to its predicated role.

Many states now have or will acquire in the next decade or so the technical ability to successfully construct and detonate a nuclear device. Moreover, the state of scientific and technical knowledge related to the design of nuclear explosives is much advanced over that of the 1940s and 1950s, and it is to be expected that these states will be able rather quickly to acquire relatively compact and deliverable designs. Although large and diverse arsenals such as that of the US will probably be beyond the technical and economic capabilities of many, once the decision to opt for nuclear weapons is taken, and the requisite resources are committed, inventories should rapidly push into the dozens or hundreds.

* Margent = margin, e.g., footnotes in modern usage.

Delivery systems are more difficult to analyze, for what constitutes a usable delivery system depends upon the mission and opponent selected. Few states will be able to pose a credible military threat to superpowers, although the threat of clandestine or subversive use cannot be discounted. Credible systems for use against similarly armed and located opponents, a far more probable scenario, will be simpler to acquire. The present situation with regard to exports of aircraft and other potential delivery systems places few limitations, other than economic, on the ability to wage local nuclear warfare.

At the moment, potential use is somewhat restricted by the survivability of expensive and scarce offensive systems in a highly developed defensive milieu. However, continued export of high-performance aircraft capable of carrying medium-range, actively powered and guided air-to-surface missiles, and the prospective development of far less expensive remotely and self-controlled pilotless vehicles (e.g., cruise missiles) could make credible delivery systems available to a wide range of states in the 1990s.

Unless there is a major shift in current military development and export policies, technical and economic barriers to the development or acquisition of battle-usable nuclear weapons systems are therefore expected to decrease steadily through the next two decades.

I. INTRODUCTION

"Nuclear proliferation" is often used as a shorthand to describe the alteration in the configuration of military and political relations among states when a single variable alters—the detonation by a state of its first nuclear explosion. The technical possibilities for proliferation so defined are relatively easy to set out. But to discuss the technical setting of nuclear weapons proliferation in the 1990s presumes an adequate definition of what is a nuclear weapon and what is a delivery system. This is not easily arrived at. To ask what might be the military uses of nuclear weapons and how they might be delivered to a prospective target requires specification of intended and perceived military and political purpose to a degree of precision that may not be matched by the actors themselves. If many small weapons are available, a state may be led to contemplate more extensive battlefield use of such weapons.[1] Conversely, if battlefield weapons are sought, stringent conditions are imposed upon weapons and delivery system design.

Not all nuclear explosives, even when intended for non-peaceful purposes, are properly termed weapons. A weapon, formally defined, is an instrument of combat—something with which to fight in battle—ranging from a rock to a rocket. In this sense, the Hiroshima and Nagasaki bombs were not weapons but instruments primarily of terror. Their aim was to weaken the political rather than the military strength of Japan.[2] For many years after, the U.S. nuclear arsenal was used more for diplomatic than war-fighting purposes—first to intimidate, then to reassert pre-war power relations and establish new ones, then to deter. Only within the NATO-WTO context has the public debate broadened to include the use of nuclear weaponry designed specifically for battlefield use.[3] Even so, there remains considerable argument over the risk of crossing the "nuclear firebreak" and conventionalizing nuclear weapons use.

Entertaining such debate, however, is a luxury reserved to the superpowers, which possess abundant supplies of weapons material, sophisticated device design teams, high-technology missile and aircraft industries, and the ability to produce complete weapon-delivery systems in great quantity and variety. Smaller states cannot afford to develop a different warhead for every purpose or potential target, nor delivery systems designed to survive in a wide variety of hostile environments.

These states may seek only enough capability for diplomatic and political gain. They may be capable of producing only systems sufficient for use as instruments of terror, or the threat of terror. Or they may seek sufficient capability for credible use in combat over a limited range of possible conflicts. In each case, the determining technical and economic factors will be different. Technical possibilities must take into account intent, purpose, military and diplomatic milieu, economic and technical resource limitations, and mission. Only within this context can preferences and purposes be compared with abilities.

II. PREFERENCE AND PURPOSE

Defining an "event" of nuclear proliferation as the detonation of a nuclear explosive device is politically convenient, for it responds to an unambiguous act. The presumption is that only intent is then lacking for the development of a weapon. By modern standards, however, this historically convenient demarcation is blurred. The continued spread of nuclear materials, technologies, equipment, and trained personnel accompanying the worldwide development of commercial nuclear power, and the attendant increase in the generally achievable level of sophistication and information, increasingly leads to a condition that has been characterized as "latent" proliferation.[4] By the 1990s there will be dozens of states that must be presumed capable of building a nuclear explosive using only indigenous capabilities if they will to do so.[5] One is hard-pressed to judge whether India, which has tested, or Israel, which has not, could make the more credible weapons threat. Moreover, should a general nuclear armament race begin, there is no question that states such as the FRG, Japan, and Sweden could arm in large numbers far more rapidly than India, Israel, or Taiwan.

Many states are already judged to be capable of building usable nuclear weapons; by the 1990s there will be anywhere from a dozen to two dozen more.[6] Whether these states will feel constrained to openly acknowledge their programs by testing is not certain. This may appear irrelevant to our discussion here, since we are instructed to assume that, in a period beginning in 1990, a dozen or more states of various size and capabilities will have or be developing deliverable, usable weapons. Nevertheless, it is important in setting the context. Those states seeking sophisticated, compact weapons, or those seeking to construct them out of commercial (fuel-cycle derived) rather than specially produced military plutonium may decide it is necessary to test to verify yields. The credibility of a given state's program may therefore depend upon testing, and the international norm against such tests will remain very important.

What a state might do does not derive solely from its technical ability, but also from the will to act and the intended and perceived purpose of that act. Moreover, a state's actions will be colored not only by what other states perceive them to be capable of, but what they believe that state would actually do in certain circumstances. This leads to four general purposes for a public demonstration by a state of either the ability to construct an explosive or of an actual, usable weapon:

(1) to prove to others it is technically capable;

(2) to build internal confidence in the ability to develop a usable arsenal;

(3) to convince others it could acquire such an arsenal;

(4) to convince others it has an arsenal and would, under appropriate circum-

stances, consider its use—either in combat, for terror, for reprisal, or as a last resort. Technical and economic requirements for these several purposes differ markedly.

The audience for such a public demonstration is not so precisely definable for smaller powers as for the binary US-USSR or USSR-China systems, or for the derivative rationales of France and the UK.[7] Without state-specific analysis that includes perceptions of evolving military and security environments, actor preferences and purposes are not easily discerned. Moreover, the purposes listed above are not completely separable, nor may it be in the best interests of some states to remove or reduce ambiguities as to purpose or capability.

The classic arms control tactic of dichotomous bargaining is, as pointed out by Schelling, not applicable in such circumstances.[8] For the states being considered here, it is not clear which might be bargained with, over what, and whether there are any mutually commensurable goals about which negotiation can take place. Furthermore, there is no referent for deciding what actor capabilities are: what might be usable (or credible) against Zambia or Peru might not be credible (or usable) against Argentina or Iran.

Rather than attempting to delve into this menagerie, the rest of this essay defines some of the technical and economic capabilities and constraints that are likely to define the boundaries of achievable weapons and delivery systems for a variety of states. This heuristic exercise is aimed more toward divining what actors might become capable of than what they might, may, or will do. Some states will be little constrained by technical and economic factors. And even those that are so constrained are not bound to interpret the meaning of a weapon or a delivery system according to the rules of the more advanced industrial and military powers.

III. WEAPONS MATERIAL

Present nuclear weapons are constructed of either U-235 or Pu-239. Both of these are also fissionable by low-energy (thermal) neutrons, and so are also usable as fuel for present-design commercial nuclear power reactors. But this is not a necessary condition. Thermal neutrons propagate a chain reaction too slowly to provide the rapid energy release required for an explosion. Weapons reactions are propagated by high-energy (fast) neutrons, and many other isotopes, such as Pu-240, that are not thermally fissionable are also potentially usable for explosives. A notable exception is U-238, which tends to absorb neutrons and convert to Pu-239 rather than fission. Even for fast neutrons, U-238 will not sustain a chain reaction.[9]

U-235 is found in nature, at a concentration of 0.7 percent of the total uranium, the remainder being U-238. Plutonium does not exist in nature, but may be bred by

neutron absorbtion by U-238 and then chemically separated. Since the irradiated uranium is highly radioactive, "hot" chemical separation facilities are required. A third potentially usable isotope, U-233, is also not found in nature, but may be bred and chemically separated from naturally occurring Th-232. Although there are some doubts as to its utility for weapons in practice, U-233 is theoretically usable, and is included here for completeness.[10]

Nuclear explosives are simple in principle. For most fissionable isotopes, there is a certain mass of material (for a given density and geometrical configuration) for which the loss of neutrons through internal absorption or out through the surface just balances the generation through fission. If the mass or density is lower, or the geometrical configuration provides a greater surface area, neutron loss exceeds generation and the chain reaction dies out. If mass or density are increased, or surface area reduced, generation exceeds loss and the chain reaction propagates. If this is done rapidly enough to prevent melting or low-energy dispersion of the material, an explosion—the rapid release of energy—occurs: energy release is governed by the amount of material fissioned before the device disassembles.[11]

Two factors are of central importance to weapons design. The first is the amount of material needed, which is related to the geometry selected, and the second is the method of initiating the chain reaction at the proper instant. To prevent accidental initiation, the material must either be kept physically separated and assembled quickly, or arranged so that density or geometry prevent a self-sustaining reaction. In both cases, the material is either assembled or brought rapidly to a proper density or geometry by the application of explosive charges (in some cases, a combination is used). Since assembly is a dynamic and rapid-shock process, initiation of the reaction at the instant when the material is in the most favorable configuration is needed to maximize the amount of energy extracted (yield).

Weapons grade uranium (nearly pure U-235) obtained by isotopic separation has such a low rate of spontaneous neutron production that initiation is required. Although initiation is also required with plutonium weapons to maximize yield, it is not for lack of spontaneous neutrons. Pu-239 produced in reactors also absorbs neutrons, converting to Pu-240—a copious neutron emitter. To prevent possible pre-initiation with consequent reduction in yield, plutonium for military purposes is kept as low in Pu-240 as practicable, which implies rather short irradiation time of the uranium fuel in the reactor. Furthermore, more sophisticated designs (such as spherical implosion) providing more rapid assembly are required.[12]

The physics and technology of initiators has progressed very far since the 1940s, and a variety of more or less obvious techniques and devices is available to any state capable of designing a weapon.

Many technical and scientific skills are required for the design and construction of a nuclear explosive, but the level of sophistication and amount of material required depend upon the yield and reliability that is sought and the degree of miniaturization. A crude device might need several critical masses; sophisticated weapons with yields in the tens of kilotons can be made with somewhat less than a bare sphere critical mass (the critical mass in air in spherical solid configuration). Table 1 lists critical masses for uranium and plutonium; surrounding the material with a good neutron "reflector"

Table 1

Critical Mass Data for Several Nuclear Materials, Spheical Geometry [a] (kg)

Tamper	U-233	U-235	Pu-239 *	60% Pu-239/40% (Pu 240+Pu-242) *
Bare	16	56	11	15
Thick uranium metal tamper	(6-9) **	15	5	8

Notes:
[a] Sources: Theodore B. Taylor, "Nuclear Safeguards," *Annual Review of Nuclear Science*, 25 (1975), 407; Ernest J. Moniz and Thomas J. Neff, "Nuclear Power and Nuclear Weapons Proliferation," *Physics Today*, April 1978, 42-51; H.C. Paxton, "Los Alamos Critical Mass Data," Los Alamos Laboratory report LA-3067-MS (Revised)
* High-density phase. In lower density delta phase, critical masses are about 1½ times those shown.
** Estimated.

lowers the critical mass by reducing neutron loss through the surface. The reflector may also serve as a tamper, adding to the inertial forces holding the material together while the chain reaction starts. Yield data are classified, but the use of a good tamper-reflector and sophisticated design is known to reduce the material requirement by a factor of more than four.

A technique for boosting yield not much discussed in the public literature until the advent of the enhanced-radiation weapon is to enclose the device in a blanket of fusion material such as LiD. The triggered multiplication of neutrons vastly increases yield, allowing for much smaller devices or much higher yields from conventional ones.[13] Boosted weapons might be too sophisticated for some of the states on our list, but certainly not for all. Thus, weapons ranging into the hundreds of kilotons cannot be ruled out.

For most of the states on our list, the material used will be plutonium. U-235 is difficult to obtain from present suppliers, and the isotopic separation technology required to extract it from natural or low-enriched material is still very expensive and difficult to construct. However, the advent of lower cost and less difficult separation technologies (such as laser enrichment) could change this situation by the end of the 1990s. U-235 would be preferable from many viewpoints, particularly for relatively crude designs, but larger devices are required owing to the greater critical mass.

U-233 has a relatively small critical mass and a low spontaneous neutron rate, and is easily bred from Th-232. However, the technology for its chemical separation is not as well advanced as for the separation of plutonium from uranium.[14] There may be additional difficulties owing to the growth of gamma radiating daughters of U-232 with time, making the material progressively harder to handle.[15] It is unlikely to be preferred if other material is available.

The cost of a committed plutonium production program would not be great. A small production reactor designed to produce relatively pure Pu-239 can be built in a few years for a few tens of millions of dollars.[16] The required hot chemical separation facility could also be built in a few years for some tens of millions of dollars.[17] Such a combination could produce enough material for a few nuclear explosives a year, or more, if design is sophisticated. There is no reason to believe that a state embarked on a dedicated weapons program would settle for less. If the program were totally open, it would be cost-effective to design and construct for some tens of weapons per year. The capital cost of a plutonium production complex of this larger scale is unlikely to exceed one billion (1976) dollars, including all radiological protection features.

The size of the deliverable weapon itself would depend more upon such other design considerations as the amount of high explosive needed than the mass of fissionable material required. It is more convenient for our purposes to combine the weight of all functional and structural components into a single index—overall size and weight—that governs the type of delivery system needed. Three categories seem useful:

- crude: total mass over 500 kg, diameter over one meter;
- median:total mass between 100 and 500 kg;
- sophisticated: total mass less than 100 kg, diameter less than 15-20 cm.

Plutonium devices would be roughly spherical. A median device of good design would be roughly 200 kg and 40-50 cm in diameter. A crude device can be the size of a small truck.

For most of the states on our list, yield will probably be in the range of a few kilotons to a few tens of kilotons, whatever the size. For some, controllable and/or boosted yields, covering the range from less than one kiloton to many hundreds of kilotons, will be available.

IV. THE COMMERCIAL FUEL CYCLE AS A SOURCE OF MATERIAL

Construction of a dedicated weapons program will take considerable time and money, although it is assumed throughout the preceding discussion that certain specific technical skills and types of supporting equipment will be available as a consequence of the use of commercial nuclear technology (otherwise time and cost would be far higher). States not having a reasonable peaceful nuclear program are therefore unlikely to develop a military one. Commercial technology may also contribute directly. If a state feels it cannot afford separate military and commercial facilities or, in times of crisis or revolution where rapid production of large quantities of weapons material is sought, the commercial fuel cycle can also be put to use—even at the cost of breaking safeguards arrangements or treaties and agreements.

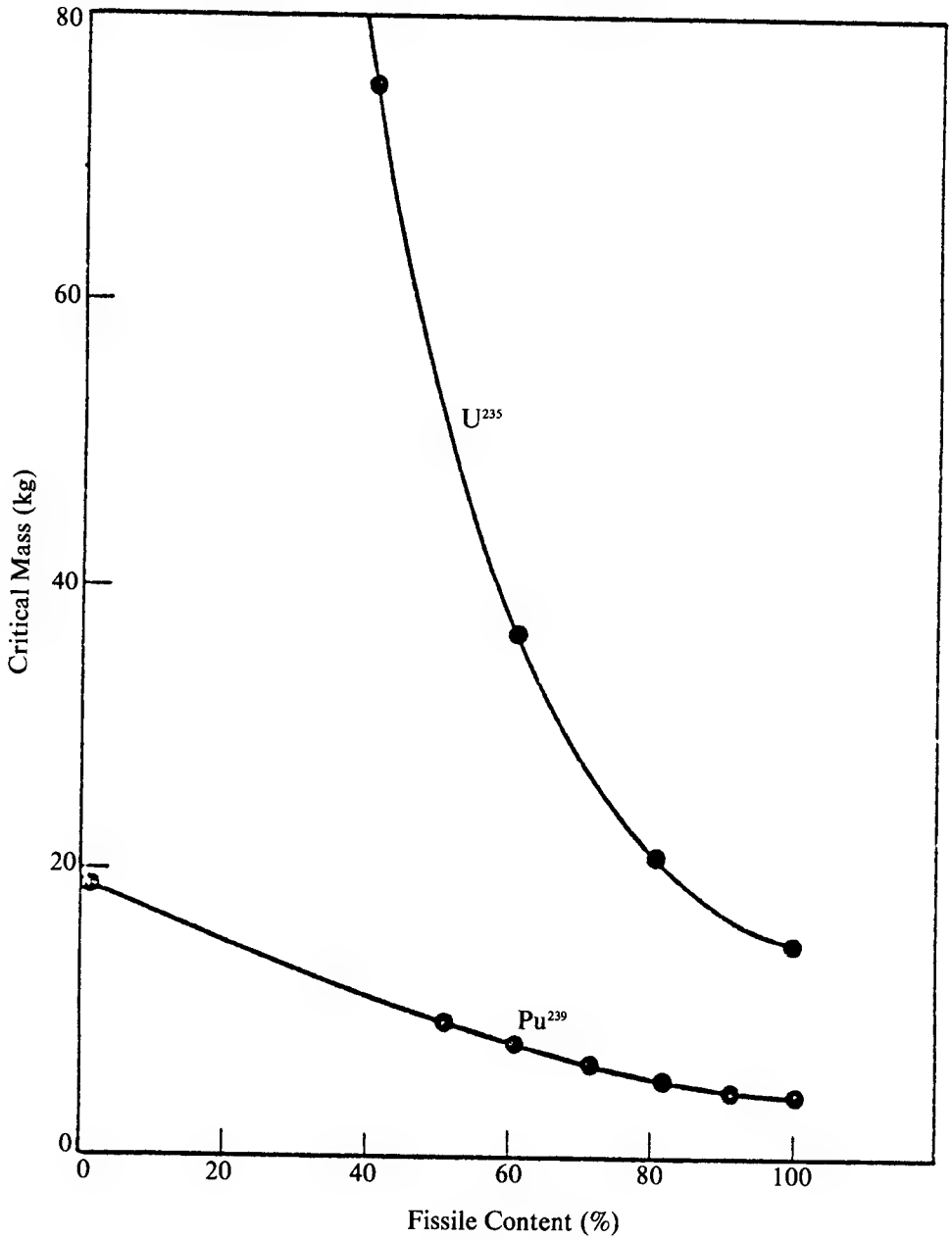
As is shown by Figure 1, low-enriched uranium (e.g. for reactor fuel) cannot be used directly. Material enriched to 15-20 percent U-235 concentration is also difficult to use for weapons. Crude isotopic separation procedures could, however, be used to produce weapon-usable material. If only a crude device is wanted, great purity is not required.[18] Highly-enriched U-235 is available for research, and sometimes for fueling of high-temperature gas-cooled reactors (HTGR). Separation from the graphite moderator is not technically difficult. Nevertheless, large quantities are not currently available, and modifications to the HTGR can remove the necessity for high-enrichment fueling.

Plutonium is produced in all but highly enriched uranium fuels. A shift from the present dependence upon uranium to plutonium fueling would make plutonium accessible in unirradiated fresh fuel, from which it could be separated fairly easily without the necessity for extensive radiation shielding. As shown by Figure 1, no isotopic mixture of plutonium available in the commercial fuel cycle is unusable for weapons. In fact, the critical mass for Pu-240 is only about four times that for Pu-239 (and less than that of pure U-235).

At one time it was believed that the presence of a large fraction of Pu-240 in commercial plutonium afforded a measure of protection, since the large neutron background greatly increased the probability of pre-initiation and very low resulting yields. The Pu-240 cannot be removed by any known isotopic separation process with any degree of efficiency, but it is now recognized that careful attention to design can greatly reduce or control the unpredictability of yield. Militarily useful devices with yields reliably above the range of a few kilotons can be constructed from fuel-cycle plutonium even with relatively unsophisticated technology.[19] Although less efficient and predictable, it will suffice for a state having no access to better material. Moreover, states possessing more sophisticated design teams can obtain reliable and higher yields.

Figure 1

The Critical Masses of Uranium and Plutonium



Notes: a. Source: Moniz and Neff, *op cit*. Both materials are assumed to be in the form of high density metal spheres in a thick uranium reflecting shell. Fissile content refers to Pu-239/total plutonium or U-235/(U-23 + U-238)

The three categories used before (crude, median, sophisticated) remain the same if fuel-cycle plutonium is used, although yields are likely to be smaller, particularly for crude devices. However, access to booster technology could still allow very large yields to be obtained.

V. IMPLICATIONS FOR DEVICE INVENTORIES

How many nuclear explosives a state would have, and of what kinds, is a matter of policy choice; the question to be addressed here is what constraints are imposed on the range of choices. Almost any state with a commercial nuclear technology program can construct a small reprocessing plant and associated production reactor for a few critical masses of plutonium per year. The facility would hardly qualify as a "plant"—it would more resemble a large experiment.

A plant capable of reprocessing 50 Mg/yr—the size of WAK at Karlsruhe and half the size of Trombay—could produce enough material for one median explosive (or two sophisticated ones) per month. The reactor to feed it would be perhaps 600 Megawatts (thermal), about one-fifth the size of commercial plants. This is the model one billion (1976) dollar program mentioned above. Diversion of commercial spent CANDU or LWR fuel in an emergency or crisis would more than double the plutonium production rate, but the plant would have to be designed for such an adaption from the outset.

Only if a state were conducting a quite small, clandestine program would rates be expected to be as low as a few weapons per year. Since this is not the assumption for this colloquium, the baseline should be taken as ten to twenty per year for a small program, with the capacity to more than double this rate in a crisis by diverting fuel cycle materials.

States having commercial-sized reprocessing plants, whose throughput is typically ten to thirty times as large, could produce dozens of weapons per month in a crisis, provided source material and other components were prepared. States using plutonium fresh fuel would also have material for many dozens of weapons, more or less at hand, that could be easily separated by more conventional, and less detectable, chemical facilities. Or, given a change in present non-proliferation norms, a state could run a joint military-commercial facility and produce many tens of weapons per year without seriously interfering with commercial reprocessing.

VI. INDIVIDUAL CAPABILITIES

Our hypothetical list of states that might have, or be considering, a capacity to build nuclear weapons includes Argentina, Brazil, Egypt, the FRG, India, Iran, Israel,

Iraq, Japan, Libya, Pakistan, South Africa, South Korea, Spain, Sweden, Taiwan, and Yugoslavia. Their potentials are quite different.

The FRG, Japan, and Sweden could rapidly acquire extensive and sophisticated arsenals, boost for high yield, and perhaps pursue true thermonuclear weapons. Most other states in this position are European.

In the next rank, Israel is limited by the availability of source material. South Korea and Taiwan also have the technical capability, but at present are under strong external political restriction against reprocessing. Somewhat behind these are India, which has some experience, and South Africa, which is rumored to be developing some. Both have indigenous uranium supplies. All of these states have an ample technical and technological base, and could be moving toward sophistication in weapons design rapidly in the 1990s.

Argentina, Brazil, Egypt, Iran, and Pakistan are further behind in the number and quality of needed technical personnel, but are already moving to improve this as part of their commercial programs. By the 1990s, all should be capable of designing and constructing median devices. Libya and Iraq are far more limited in experience and personnel, and would be restricted to crude devices in the 1990s unless a major push for training occurs. Of course, most OAPEC states are not poor; they have ample funds to hire needed expertise if they so desire. Industrial infrastructure limitations are likely to be the major constraint.

More than half the states on our list could have some hundreds of fairly sophisticated nuclear devices available by the mid-1990s, allowing for possible battlefield use even where losses are high. The rest are likely to be limited at first to smaller numbers of median devices, but could be moving rapidly toward larger numbers and more sophistication by the end of the 1990 decade.

Both technically and economically, restrictions on the availability of delivery systems would then be the more important consideration. But these are also likely to become more widely available, and less expensive.

VII. DELIVERY SYSTEMS

Technical barriers against development of nuclear explosives are becoming lower, even as states strive to keep political barriers and norms against their development and use high. For delivery systems, on the other hand, technical and economic barriers have been growing in a near absence of political barriers or norms against their export.

A usable delivery system entails, to some extent, the penetration of enemy territory against detection and defense that is becoming increasingly sophisticated. This is why the technical-economic barriers have been growing. The great powers have been exporting all but their most advanced electronic technologies (and sometimes even those) along with their latest aircraft, missile, and other systems, with general restrictions applied only to unambiguously nuclear delivery systems such as the Pershing missile. Therefore, a state considering conflict with a similarly armed neighbor must worry about the credibilty and reliability of its force. However, it is now feared that new weapons developments will lower technical barriers and, by blurring the line between offensive and defensive, conventional systems and nuclear ones, make the imposition of controls more difficult.

ICBMs and Polaris submarines are not needed; the range of military possibilities is much broader for the states on our list than for superpowers contemplating fighting a full-scale war across many thousands of km. A delivery system is no more than a means for reliably placing a weapon before detonation where it is wanted. It is necessary, therefore, to run through a gamut of possibilities.

A. Ballistic Missiles, Submarines, and Long-Range Strategic Bombers

None of these delivery systems—which are the backbone of the US strategic forces—is likely to be acquired by even the most advanced of the states on our list by the 1990s.[20] However, intermediate-range ballistic missiles, and the retrofitting of existing submarines or surface ships to carry them are possible. The advent of the cruise missile (discussed below) would allow a variety of aircraft to be used as the equivalent of long-range bombers. Guidance systems are a major stumbling block in missile development, but the prospect of improved commercial guidance systems or precision navigational aids (e.g., by satellite relay) could seriously lower—or remove—this technical barrier.[21]

B. Shorter Range Missiles

A variety of short-range ballistic missiles are now on the international arms market, and many more are likely to appear in the next decade or two. The US is reluctant to market the 600-km range Pershing for now, but as shown by Israeli development of the comparable Jericho and the recent Taiwanese unveiling of their new missile, indigenous capabilities are increasing to the point where that soon may not matter. Shorter range battlefield missiles such as Lance, Frog, and Scud are already widely exported; in geographically compact arenas they are semi-strategic as well. Ship-launched missiles such as Harpoon, Exocet, Otomat, and Gabriel can be

adapted for shore targets or land use. They are a bit small except for very sophisticated nuclear weapons, but larger versions could easily be developed.[22]

Tactical missile development is being avidly pursued by many states, and the line between those that are nuclear-capable and those that are not blurs as size and weight of the missiles increase. With the addition of laser-designated, inertial, or data-link guidance, these missiles could become formidable in arenas where distance is measured in hundreds rather than thousands of km. In the Middle East or Southeast Asia, the high-speed, missile-armed patrol boat could be used as an effective threat or deterrent, as a first-strike, or as a quick-response weapon.

C. Fighter-Bomber Aircraft

Paradigmatic of delivery system ambiguity is the F-15; now being exported only to a few states, exports of the F-15, its successors, or European or Soviet equivalents, may increase and spread. Sold as an interceptor, the F-15 (capable of carrying many thousands of kg) is a formidable delivery vehicle, and may be considered not only a tactical, but a strategic nuclear delivery vehicle in many parts of the world. Other nuclear-capable high-performance aircraft that are widely exported include the ubiquitous F-104, F-4, and F-5, and the new F-16 from the US, the French Mirage III, V, and F-1, the multinational Specat *Jaguar* and Panavia *Tornado,* and the Soviet MiG-21, MiG-23/27, and the Su-20/22 export versions of the Su-17. France has a new Mirage 2000, Israel the new *Kfir* C2, and Sweden is seeking customers for its Saab 37 *Viggen*. All can carry nuclear weapons, although capabilities vary. The Mirage F-1, for instance, although sold as a lightweight high-performance fighter, has four hard points for mounting 450 kg external ordnance.

Among slower aircraft of higher payload, the US A-4 is widely exported and the A-7 could be. There have also been sales of medium bombers, notably the Hawker-Sidley *Buccaneer* and the widely-produced *Canberra,* and some export of the Soviet Tu-16 (a cruise missile carrier). All are low and slow by modern standards, and are likely to remain survivable in the 1990s only in areas (such as South America) where export restrictions by the great powers continue to be enforced.

New vehicles are likely to become available. For instance, the new F/A-18 is rated for over 10,000 kg of external ordnance, and technical data for export licensing have already been applied for by at least nine states.[23]

D. Other Aircraft

Depending upon the mission chosen, the expected level of air defense along the mission track, and the risk of loss that can be accepted, nuclear explosives can be

carried by a variety of aircraft ranging from giant 747s to *Alphajets* and T-28s. Although not suited for land war in Europe, these aircraft may be adequate for smaller states under appropriate circumstances, and may provide conveniently confusing delivery for surprise. If cruise missiles are developed, large commercial aircraft become effective long-range stand-off bombers, operating almost totally within territorial or other heavily-defended airspace.

E. Penetration

F-15 and similar aircraft can be used for high-speed, high-altitude penetration, particularly if accompanied by air-defense suppressor aircraft. Low altitude roles are becoming more possible with the export of better avionics. The Mirage 2000, for instance, is proudly advertised as possessing automatic terrain-avoidance radar navigation. Some states, such as Israel and Taiwan, may also find a lucrative market in exporting such advanced guidance to retrofit aircraft exported without it.

F. Ordnance

With respect to size, the AIR-2A nuclear air-to-air missile, designed in the 1950s for air defense, weighs less than 400 kg, including rocket motor, whereas the standard aircraft ordnance fitting is 450 kg for "light" pylons. Many of the states on our list could easily match this technology now, and many more will be able to by the 1990s. Air-to-surface guided missiles with ranges upwards of 100 km (resembling the current Anglo-French Martel or German Kormoran, or the larger German Jumbo or Swedish RB-04) should become widely available.[24]

Guidance technology should diffuse rapidly. "Smart" bombs such as Walleye (already available in a nuclear-capable model) and Maverick, both used in Vietnam, are only the beginning. Guidance systems can even be removed from smaller systems, such as Maverick, and refitted to nuclear-capable ones, or replicated. There is no reason to doubt that there will be a variety of potential suppliers by the 1990s, even for states not capable of indigenous development.[25] As an intermediate step between free-drop bombs and internally-guided cruise missiles, these smart systems will be the most effective from both cost and military viewpoints. Their frequent neglect in analysis is a serious oversight.

G. Cruise Missiles

Externally guided vehicles, whether winged or true ballistic, are becoming obsolete. Cruise missiles are internally guided, using stellar or automatic data-link guidance, or terrestrial mapping systems such as the newly-developed TERCOM fourier-transform radar navigation. They may also be winged or wingless—low-speed

ground-hugging miniature aircraft, high-speed sprint missiles, or any combination in between.[26]

Cruise missile technology is within the reach of many small states. Neither airframe nor engine technology should be much of a problem. The US is developing its advanced ALCM and SLCM to be high-performance, low cost, and fittable to existing bomber and submarine fittings. Smaller states do not operate under such restrictions. Since they will seek at most hundreds, rather than thousands, and may be content with ground launch, larger and far more expensive cruise missiles can be afforded. Only the poorer and less technically advanced states on our list do not have an aircraft industry of some type. Engines such as the 1350 kg thrust GE CJ610-6 used for business aircraft are widely available without restriction. Several engines in the 500 kg thrust class, the size intended for ALCM and Otomat, are becoming available, and may become more openly purchasable by the 1990s.[27]

Self-guidance technology for countervalue targeting will increasingly fall within the capabilities of smaller states within the next two decades. Inertial guidance systems unsuited for the high g-loads of ballistic missiles are more adaptable to cruise missiles, and high accuracy is not always required. Advanced TERCOM, desired by the United States to allow for flexible programming against many types of targets, may not be needed. If targets are pre-designated, launch point adaptability is all that is required. Some targets, such as cities on bays, are so clearly identifiable as to present little difficulty. Furthermore, the principle behind TERCOM is not at all mysterious. It is primarily an advanced electronic engineering problem, and many states are progressing very rapidly in electronics. Miniaturized components are becoming cheaper, more efficient, and more widely available almost daily. By the 1990s, even complete TERCOM systems could be available on the international arms market.

The prospective spread of cruise missiles for what are ostensibly conventionally-armed missions presents difficult verification problems. A missile with a 500-kg high explosive warhead and a range of 600 km, for instance, could be configured to 1500-km range with a 200-kg nuclear warhead and 300 kg of extra fuel. It would be externally indistinguishable. France and the UK, among others, are now considering adopting cruise missiles for nuclear delivery, and there will be a temptation to recover some costs by marketing conventionalized versions abroad. Moreover, development times for cruise missile technology are likely to be far shorter than for piloted aircraft, and several new missiles could appear by the 1990s that are not now under design.[28]

H. More Exotic Delivery Systems

Many of the states on our list do not have potential opponents so far removed or tightly controlled as does the US. Many of these depend upon imports for basic goods

even during wars. Nuclear explosives could be smuggled in as surface or air freight, perhaps via a third (neutral) party, and detonated remotely or upon customs inspection or simply upon arrival at dock or airport. If shipped as containerized cargo there would be ample room and weight for thorough shielding against casual inspection. Such delivery is, of course, always available as a first or pre-emptive strike option against almost any unwary target, not excluding the US. Thus, the spread of nuclear weapons can pose a serious, if limited, threat even to the superpowers.

VIII. COMMAND AND CONTROL

Perhaps of even greater concern to the US and other world powers, as well as to states such as Israel and South Africa whose legitimacy itself is challenged by others, is assurance that deployed nuclear weapons remain under the command of central governments and under secure control. A variety of command and control procedures is needed to ensure that weapons are not usable by local or field commanders without consent of political authorities, or do not become usable at home or abroad during times of revolution or civil disorder when authority itself is not clearly defined. There is also need for security against theft by terrorist, insurrectionary, or criminal groups, since these weapons could be sold abroad as well as used for domestic threat. This range of problems has been a concern even for US and Soviet forces in Europe.[29]

It would clearly be in the interests of the great powers to aid and assist with the development and use of adequate physical security measures. It is possible that this would extend to assistance in devising central control procedures and technologies, such as the permissive action link (PAL) used to ensure that US weapons cannot be detonated without authorization. However, the US would probably be reluctant tc divulge too much detail of PAL to states whose secrecy and security for such information is sometimes questionable. This will present a considerable dilemma.

Yet another dilemma is likely to be posed if military, security, or political concerns are so great that larger powers insist upon the adoption of command and control measures or the fitting of PAL. If the transfer of this technology is insisted upon, smaller states could extract a considerable price—ranging from assistance with weapons or delivery system-design to alliance and security agreements—for their adoption.

IX. WHAT FORCE STRUCTURE MIGHT STATES CONSIDER?

With the exception of the FRG and Japan, the states being considered here are unlikely to commit the technical and economic resources needed to develop multi-mission, multi-role mixed strategic and tactical forces even at the scale of the UK or France. Some simply will not be able to afford it even if they so desired. In a rational

world, these states would select forces appropriate to specific missions against a range of anticipated opponents.

The first matter to be settled is that of basic posture. Nuclear explosives can be used strictly as a deterrent, to demonstrate early commitment, to improve bargaining position, for political dominance, hegemony, or equivalence, either regionally or locally, to improve combat ability, or strictly for defense. Depending upon whether the weapons are seen as instruments of combat, of terror, or simply as defensive supermines to secure borders, different structures must be considered.

This does make a technical difference. If deterrence is sought, forces must be capable of riding out a pre-emptive strike and providing a credible response. If primarily used for "coercive diplomacy," less survivable forces may still be acceptable.[30] Forces intended for battlefield, interdiction, or purely defensive roles can be less sophisticated, since they can be hidden and brought out on short notice without the need to be constantly up and ready for use. Moreover, and unlike the traditional European situation, these states are likely to have a range of potential adversaries in mind, some neighboring and some more distant, and a correspondingly diversified set of forces. Finally, there is no assurance that all the states on our list will behave rationally and select forces appropriate to the roles perceived by others. For such nonrational (but not irrational) motives as the desire to emulate superpowers, they may opt for seemingly global delivery systems.

This apparent confusion will not be perceived by the states themselves, since each will have specific missions in mind, but it does introduce a great deal of complexity into global analysis. Even though the US has twice considered the use of nuclear weapons in Asia, the present range of possible nuclear warfare scenarios is comparatively simple. With the extension of nuclear weapons to large numbers of other states, there would be the need to analyze a host of potential smaller and more diverse conflicts to try and determine whether and where nuclear-capable states involved might decide to use their weapons, what might be done to intercede, and what the implications are of either the use or the intercession.

X. VULNERABILITY

An important consideration will be the relative vulnerability of different forces and force mixes in combat or to pre-emptive strikes. Hardening against full-scale nuclear attack is an option available to states with offensive missile forces, since the technology to defend against the limited attacks of similar opponents should not be too difficult. Resistance to superpower attack is probably out of the question technically. However, the forces being considered for most of our list in the 1990s will be relatively

vulnerable aircraft or similar systems, and secrecy and concealment in deep mines or caves are likely to be the dominant protective mode. This does slow response, however, and may make a pre-emptive strike more attractive to opponents.

Another contributing factor to the risk of pre-emptive strikes is the greater vulnerability of embryonic forces seeking parity with an opponent. Clearly, there will be periods of great risk during the development and deployment phases as these countries arm—perhaps much greater than the risk once all are actually armed. When large numbers of weapons are produced, it is difficult to be sure that there are not many concealed for future retaliatory use via infiltration or other clandestine delivery. Unlike the technical race for invulnerability among the superpowers, among the smaller powers invulnerability is likely to depend more upon intelligence and espionage and, consequently, be less stable.

XI. TECHNICAL LIMITATIONS

With regard to weapons, none of these states is likely to have megaton-yield devices in the 1990s, although the more advanced, through boosting, could have weapons in the hundreds of kilotons. Leaving aside ICBM or missile-submarine forces as unachievable in our assumed time frame, the more advanced states such as Japan and Sweden could probably develop almost everything they might want. Israel and Taiwan, and other similar states might be restricted to shorter range systems but, aside from this, should be able to build or purchase much of what they need with minimal outside assistance. Libya and Iraq, at the bottom of our list technically, would have more difficulty owing largely to restrictions on indigenous technical and industrial skills. However, it is possible that they too could purchase almost everything they need — including personnel. Much depends upon the future development of arms sales markets, both open and "gray."

This is an area where more detailed state-specific analysis is required. For those states not now capable of designing and constructing their own components and delivery systems, how much improvement is anticipated in the next decade, and at what level? To what extent can some lines of development or acquisition be blocked by weapons-exporting states if identified? Where might political agreements slow or prevent the diffusion of specific, needed technologies? Research in these areas is pressing and important.

Nevertheless, it should be realized that many of the states on our list are already capable of complete, or near-complete, indigenous development and construction of complete weapons and delivery systems suitable for at least local and regional conflict.

XII. ECONOMIC LIMITATIONS

For many of these states, the question is not what they would like to have or are capable of developing or purchasing but how much they can afford. The US can afford to spend several billions of dollars a year on nuclear weapons. (Perhaps in the larger sense it cannot but, in budgetary terms, it not only can but does.) Smaller states are more restricted. The question is: What are their limits?

Table 2 lists some recent military budgets for some of the states on our list, both absolutely and as a share of national budgets. For comparison, our reference ten-to-

Table 2

Military Expenditures [a]

State	1974 National Budget, US $ * (billions)	1974 Military Expenditure, US $ (billions)	Percentage of Budget for Military, 1974	1976 Military Expenditure 1978 US $ ** (billions)
Argentina (1972)	4.7	0.70	15	1.21
Brazil	7.9	1.20	15	1.52
Egypt	2.35	3.14	***	4.0
FR Germany ††	—	12.0	—	15.5
Iran	10.8	4.73	44	9.4
Israel	6.2	4.62	75	4.06
Japan ††	—	3.40	—	5.0
Pakistan	1.71	0.57	33	0.78
Sweden ††	—	1.81	—	2.43
Taiwan	2.27	0.86	38	1.14

Notes:
[a] Source: 1978 SIPRI Yearbook.
* 1974 data presented at 1974 exchange rates, except as otherwise noted.
** 1976 data converted to 1978 prices and 1978 exchange rates.
*** U.S. ACDA data show 1.5 billion, and 70%. SIPRI data show more than 100% of budget for arms, an obvious discrepancy.
†† Data given are for 1973, expressed in 1973 exchange rates.

twenty weapon per year program is assumed to cost about one billion (1976) dollars, and take five years to construct.[31] Including operating costs, each weapon would cost about $20 million (1976) dollars.[32]

Delivery systems and associated defense do add considerably to the expense. Let us assume the following moderately diversified force structure:

—20 F-15 type aircraft at $25 million (1976) dollars each:	$500 million
—40 F/A-18 or equivalent at 10 million dollars each:	400 million
—200 "Walleye"-type guided bombs at 0.5 million dollars each:	100 million
—200 cruise missiles at 1 million dollars each:	200 million
—4 Lance-type missile brigades at 100 million dollars each:	400 million
Total direct acquisition cost	**$ 1.6 billion**

Adding another 800 million (1976) dollars for support and infrastructure, radar, training, and so on, the total cost would be on the order of 2.4 billion dollars, spread over five years.

Allowing about 25 percent for cost escalation (not inflation), the total force cost would be about 4.25 billion (1976) dollar, or about 850 million dollars per year over a five-year deployment period—somewhat less if amortized over seven years or a decade. There are no states on our list that could not afford this, albeit in some cases with some strain. Other states could easily afford it.

XIII. TECHNICAL AND INDUSTRIAL INFRASTRUCTURE

Two other limitations may be more serious. A state not having adequate technically trained personnel or industrial infrastructure would have to expend far greater sums than the direct costs mentioned above. However, even states toward the economic bottom of our list, such as India, Pakistan, and Korea, have long traditions of education and training, and weapons and delivery systems require only modest numbers of highly trained personnel, not enormous quantities of moderately trained ones.[33] Those states with commercial nuclear industries underway or under development are already developing most of the needed technical and industrial base. Others, such as Israel, Brazil, and India, have aircraft industries of their own, capable of producing cruise missiles and other types of systems. Sweden, Israel, Japan, and the FRG, have high-technology industries capable of very advanced ones. Except for these four, the ability of states to pursue indigenous weapon system development may be restricted by the need to import foreign personnel and acquire related necessary industrial skills.

Military infrastructure is also in need of detailed analyis. It has been widely noted that some states (Saudi Arabia for example) cannot make effective use even of the conventional weapons they have purchased. To effectively integrate nuclear weapons into existing forces, some states will have to upgrade their overall military capabilities considerably in the next decade, and that could require large investments of time,

personnel, and money. If delivery systems are purchased abroad, however, and are not clearly identified as nuclear, weapons suppliers may provide assistance in training and upgrading indigenous personnel, as they now do for advanced fighter aircraft they export. Moreover, the perceived need to assist with PAL or other command and control systems, even for an openly nuclear force, may lead the US and others to upgrade local forces for the sake of their own overall security or military position.

XIV. CONCLUSIONS

Purely technical and economic constraints do not limit any of the states on our list from acquiring nuclear weapons and delivery systems capable of, at the minimum, providing a credible threat to neighbors. For many, this would be adequate. Others may seek more, and many are capable of acquiring far more. Nevertheless, only the FRG and Japan, the most capable on our list, could seek as much as parity with France as nuclear powers by the end of the 1990s.

Development and exports of more sophisticated defense systems over the next decade could, however, severely limit the ability of many of these states to provide a credible threat of military use against an alert opponent. Whether this is stabilizing or destabilizing will depend upon the local context. Little can be done to prevent pre-emptive, clandestine, or sneak attacks on many of these states, since they present only a few targets worthy of nuclear attack, and only small numbers need be delivered. On the other hand, this does allow for more effective territorial defense, once alerted.

Whether any of these states would consider nuclear devices as battlefield weapons, either in combat or for interdiction, is more doubtful. There are still norms against such use. Moreover, nuclear weapons will be expensive and not very numerous in the 1990s, even assuming full-scale programs are started in the 1980s. By the end of the century, however, rapid production and the development of less extensive delivery systems such as cruise missiles could remove both economic and scarcity barriers to battlefield use.

What could be done to delay or halt such developments through controls on weapon and technology exports and transfers is in need of further study. High-performance aircraft, short-range missiles, and guided bombs are all marked for present or future export as conventional weapons. Inertial guidance and TERCOM are at present more restricted, but indigenous capabilities could greatly increase over the next decade. Although superpower technology will also advance, the states on our list are generally more likely to engage in conflict with one another, and the latest technology may not be deemed necessary.

What could be done to slow the spread of nuclear explosives themselves has been the subject of much recent discussion and study. It is more a political than a technical problem. I have assumed, in line with the predicate of our colloquium, that states will proceed openly with committed programs rather than adapt or divert commercial materials or facilities. In any case, the existence of commercial nuclear technology supplies much of the needed training and infrastructure. However, the marginal cost of developing an effective nuclear force can be much smaller than that cited here if diversion, theft, or open co-use of commercial materials, technologies, and facilities is chosen. Moreover, the marginal costs of delivery systems can also be much reduced if adapted from conventional use (for example, the F-15) rather than specially designed.

The ability to acquire systems on the economic and technical margin raises the possibility of instability in time of crisis, for states could seize and adapt existing nuclear and military instruments very quickly and (by comparison) if the incentive to do so overcomes treaties, agreements, and norms prohibiting such action. Over the next decade or two, the states on our list and others will progressively edge closer to becoming nuclear-capable, even if they have no intention of doing so. By the 1990s the marginal costs of acquiring usable nuclear weapons may become so low that states may find the decision far easier than it is now. If such diffusion is to be prevented, political barriers against taking the nuclear weapon decision will have to be made higher and stronger. Technical and economic barriers are becoming increasingly unreliable as technical and industrial skills and military capabilities increase.

The proliferated world of the 1990s contemplated here will have to be policed by political, military, security, and export assistance and control measures in great variety and complexity if some local conflict or event is not to trigger the first use of nuclear weapons since the largely unexamined decisions of 1945. And it is the political and normative effect of their use rather than the direct impact that is likely to have the most wide-ranging implications for future conflicts. Perhaps it would be best to end this essay where it began, with the last scene of *Hamlet*:

> Horatio: And let me speak to the yet unknowing world
> How these things came about. So shall you hear
> Of carnal, bloody, and unnatural acts,
> Of accidental judgments, casual slaughters,
> Of deaths put on by cunning and forced cause,
> And, in this upshot, purposes mistook
> Fall'n on the inventors heads. All this can I
> Truly deliver.
> *Hamlet*; Act V. scene ii.

FOOTNOTES

[1] M. Leitenberg, "Background Information on Tactical Nuclear Weapons," in *Tactical Nuclear Weapons: European Perspectives*, ed. Frank Barnaby for SIPRI, London, Taylor and Francis, 1978, pp. 3-136, points out that this was largely true of the development of tactical nuclear warfare doctrine in NATO. This is borne out by other articles in the collection.

[2] Martin J. Sherwin, *A World Destroyed: The Atomic Bomb and the Grand Alliance*, New York, Knopf, 1975.

[3] *Tactical Nuclear Weapons, op. cit.* Each of the ten authors in this volume discusses this to some extent.

[4] This idea was first advanced by Harold Feiveson. For an excellent discussion and analysis, see Ted Greenwood, Harold A. Feiveson, and Theodore B. Taylor, *Nuclear Proliferation: Motivations, Capabilities, and Strategies for Control*, New York, McGraw-Hill for the Council on Foreign Relations, 1977.

[5] Thomas C. Schelling, "Who Will Have the Bomb?", *International Security*, Vol. 1, No.1, Summer 1976, pp. 77-91.

[6] Albert Wohlstetter et, al., *Moving Toward Life In a Nuclear Armed Crowd*, Los Angeles, Pan Heuristics, 1976, provide a useful categorized list.

[7] See, for example, Geoffrey Kemp, "Nuclear Forces for Medium Powers," *Adelphi Papers* No. 106, 1974, for Part I; and 107, 1974, for Parts II and III, (London: International Institute for Strategic Studies, 1974) for the rationale for medium powers. Similar issues for smaller powers are discussed by Richard K. Betts, "Paranoids, Pygmies, Pariahs, and Nonproliferation," *Foreign Policy*, Vol. 25, 1977, pp. 157-183.

[8] Thomas C. Schelling, "A Framework for the Evaluation of Arms Control Proposals," *Daedalus*, Vol 104, No. 3, Summer 1975, pp. 187-200.

[9] In technical terms, the cross-section for neutron absorption is so large compared to the fission cross-section over the whole energy spectrum that the fission of one atom has less than unit probability of triggering fission in another. It is not just that the critical mass is "infinite." There is no critical mass for U-238.

[10] Cf. "Report to the American Physical Society by the Study Group on Nuclear Fuel Cycle and Waste Management," *Reviews of Modern Physics*, Vol. 50, no. 1, Part II, January 1978, p. S 102.

[11] The complete fissioning of 570 grams of material provides the energy equivalent of 10 kilotons of TNT, by convention. Early weapons had very low efficiencies, and large quantities of material were required to get appreciable yields.

[12] These are also useful for uranium weapons, but are not required. Simpler, gun-type assemblies can be used.

[13] Only recently, and especially since the advent of the enhanced-radiation weapon ("neutron bomb"), has boosting become much discussed in the open literature. For example, see the discussion in Fred M. Kaplan, "Enhanced Radiation Weapons," *Scientific American*, Vol. 238, No. 5, May 1978, pp. 44-51.

[14] "Report to the American Physical Society," pp. S40, S169-S170.

[15] "Report to the American Physical Society," p. S154.

[16] John R. Lamarsh, "On Construction of Plutonium Producing Reactors By Small and/or Developing Nations," *Nuclear Proliferation Factbook*, Washington, D. C., GPO, 1977, pp. 533-562.

[17] John R. Lamarsh, "On the Extraction of Plutonium From Reactor Fuel by Small and/or Developing Nations," *Nuclear Proliferation Factbook*, pp. 563-585.

[18] See Figure 1. Critical mass data are not a good guide to yield, which will decrease somewhat more sharply than indicated by this data.

[19] Office of Technology Assessment, U.S. Congress, *Nuclear Proliferation and Safeguards*, New York, Praeger, 1977, Chapter VI.

[20] Wohlstetter et al., op., cit., Chapter V, thoroughly analyzes this for Japan, one of the most advanced states on our list.

[21] For example, see Deborah Shapley, "Technology Creep and the Arms Race: Two Future Arms Control Problems," *Science*, October 20, 1978 pp. 289-292.

[22] *Aviation Week and Space Technology*, 1978 Aerospace Forecast and Inventory, March 13, 1978, provides a useful list.

[23] Much of this data came from *Aviation Week*, March 13, 1978. Another useful source is John W. Taylor, ed., *Jane's All the World's Aircraft*, published annually by Jane's Yearbooks, London.

[24] *Jane's All the World's Aircraft*, 1977-78, London: Jane's 1978; also see *Jane's Pocket Book of Missiles*, ed., Ronald Pretty, New York, Collier, 1976.

[25] "Smart" bombs are extensively discussed in Tom Gervasi, *Arsenal of Democracy: American Weapons Available for Export*, New York, Grove Press, 1977.

[26] Kosta Tsipis, "Cruise Missiles," *Scientific American*, 236, no. 2, February 1977, pp. 20-29 provides a brief, non-technical, and clear description of TERCOM and cruise missile technology for the lay person.

[27] *Aviation Week*, March 13, 1978. Also see the section on engines in *Jane's All the World's Aircraft*.

[28] *World Armaments and Disarmament*, SIPRI 1978 yearbook, London, Taylor and Francis, ~~1978 pp. 445-454~~.

[29] *Tactical Nuclear Weapons*, especially pp. 40-49.

[30] Thomas C. Schelling, *Arms and Influence*, New Haven, Yale University Press, 1966, pp. 170-184.

[31] All costs are expressed here in 1976 U.S. dollars in an attempt to cope with unpredictble and variable inflation rates; cf. the difficulties encountered by SIPRI in comparing arms budgets in the 1978 yearbook.

[32] For comparison, the cost of new nuclear artillery shells for the U.S. 155-mm and 8-inch guns in Europe was estimated to be about $400,000 each in the early 1970s. See *Tactical Nuclear Weapons*, p. 55. The inference there was that material cost was dominant. Of course, the small programs considered here do not achieve the economies of scale of large U.S. or Soviet plants. Uranium shells were estimated at about 1 million dollars each for the same weapons. Ibid., p. 230.

[33] Dwight H. Perkins, "Asia's New Economic Environment," *Bulletin of the Atomic Scientists*, October 1978, pp. 11-18, discusses the relative technical abilities of several Asian states. However, he overestimates the total cost of a modest nuclear weapon program.

NORTH-SOUTH RELATIONS IN A WORLD OF MANY NUCLEAR POWERS

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ABSTRACT

The less developed countries of the "Southern Hemisphere" are confronting the highly industrialized states of the "Northern Hemisphere" with redistributive demands of a political, military, and economic nature. The world of the South no longer wants to be dominated militarily by the great powers of the North, insists on complete autonomy, and asks for substantial changes in the international economic order.

On the assumptions prescribed for this paper, it is estimated that the spread of nuclear weapons to the South by the early 1990s will probably help the Third World—even though not in direct and obvious ways, and not spectacularly—to achieve in part all of these goals.

While the great industrial powers will remain, in absolute terms, far superior in military capabilities (as reflected in their share in world military expenditures), nuclear proliferation will add to the relative international shift in the distribution of military forces that has recently taken place with reference to modern conventional armament. Countries of the South will obtain little credible deterrence—and no power of compellance—as long as rational decision-making prevails, but a number of factors are likely to make the great powers less disposed to intervene militarily, and make them more disposed to decouple themselves from entangling alliance commitments, in the Third World. Both developments would increase the autonomy of the South.

Nuclear arms, except perhaps in the hands of terrorists, will not be used, even for purposes of serious threat-making, in support of economic-order demands. It is possible that nuclear proliferation in the South will have consequences disrupting to its unity on NIEO, and thus prove counter-productive.

Yet indirect effects will probably work in the other direction. These are: Northern concern about the possible emergence of nuclear terrorist movements; the ability of the South to create economic disruptions undeterred by any Northern threats of military reprisal; the demand for economic concessions in exchange for arms control schemes desired by the industrial world; and the perceived interest in Northern states to foster, in a highly interdependent world, a modicum of global order by supporting stability in the Southern hemisphere.

I. INTRODUCTION

The purpose of this paper is to speculate on how the emergence, by the early 1990s, of a substantial number of additional nuclear-weapons states, many of them LDCs, might affect the global relationship between the highly developed countries of the "North" and the less developed states of the "South." While the "North" generally is meant in this context to include all the industrialized countries, including the USSR and the communist states in Eastern Europe, in this paper we will refer to the industrial and more or less capitalist and democratic countries—often also referred to as the "West"—when speaking of the "North." The reason is that the demands of the South for a new economic order are directed entirely to this set of states. The South's demand for freedom from unwanted military interference is, to be sure, directed to the Soviet Union as well. However, even in this area of concern, the world of the South as a whole is, because of past experiences, somewhat more anxious about future threats from the West than from the USSR. When speaking of the "South," we will be referring to the LDCs or to the Third World to which nearly all LDCs belong.

II. THE NORTH-SOUTH CONFRONTATION OF THE 1970s

It became increasingly clear during the 1960s and 1970s that the LDCs were in full revolt against the existing international political and economic order. They regarded this order as a legacy of the past imperialist and, more latterly, neo-colonialist dominance of the capitalist powers, and the vast North-South disparities in international power and wealth as fundamentally unjust. In the economic area, the immediate and concrete demands of the South were: more stable and higher prices for the raw materials and foodstuffs exported by the LDCs, freer access for their industrial products to the rich markets of the North, the rescheduling and reduction of Third World debts, financial aid without strings attached, and recognition of their sovereign rights to regulate and, if desirable, nationalize foreign multinational corporations. The South also pressed for a larger share in the authority over decision-making in critical international institutions, such as the IMF, the World Bank and GATT, so that, in the future, it would not have to depend on Northern concessions on substantive issues but could ensure a better deal as a result of shared authority.

In the political and military areas, the Third World wanted not only to eradicate the few remnants of formally colonial structures, but also to bring an end to the politico-military dominance of the great industrial powers in particular regions and in the world as a whole. To be at the mercy of the great powers and their interventionary proclivities was no longer tolerable. Consolidation of LDC independence and autonomy required Northern, including Soviet, use of military force to be curbed and global North-South disparities in military strength to be diminished. The LDCs resented being treated as mere objects of arms control, as in the Non-Proliferation

Treaty (NPT), and being used as pawns in great-power rivalry. The vast majority of Third World states adhered to a posture of non-alignment in the East-West confrontation even if some of them, facing grave security problems within the Third World, sought protection from Northern patrons. Finally, the countries of the South opposed the preoccupation of the North with the East-West conflict and insisted on a reorientation of world politics that would make it center on the issues turning on the North-South axis.

In the eyes of Third World elites, the military, political, and economic issues that united the South against the North were closely interlinked. Military security from great-power aggression and political autonomy, on the one hand, and economic improvement, on the other, depended on one another. Despite the recent growth of international interdependence, however, the Third World was not out to revolutionize the basic organization of the international system that rested on the sovereignty of individual states. The LDCs did not clamor for a change *of* this system. On the contrary, they wished to make their separate sovereignties real in terms of independence. Toward this end, they required changes *in* the system that amounted to a radical international redistribution of world resources, and of the welfare and influence which the possession of these resources tends to generate.

By the second half of the 1970s, the industrial capitalist states of the North had begun to meet with the LDCs to discuss specific demands for a new international economic order (NIEO). The OPEC countries had greatly and abruptly raised their share in the world's income and wealth and acquired some considerable economic leverage over the oil-importing nations of the North; and a small number of other LDCs were making rapid progress in industrialization. The South was greatly increasing its share, even if absolutely speaking still very small, in global military expenditures and imported large amounts of modern armaments from the North. Soviet-American animosity and rivalry tended to restrain military intervention by either great power in various parts of the Third World. Moreover, political constraints—largely the aftermath of an unfortunate military intervention in the Third World—had sharply reduced the disposition of the United States to become militarily involved in the affairs of the South. Compared with only a decade earlier, some diffusion of international power and influence was definitely in train.

Yet the South remained deeply dissatisfied in its challenge of the privileged North. In terms of income per capita, most LDCs were making little, if any, headway toward closing the glaring gap in the distribution of the world's economic product, and many of them were stuck in abject poverty. The North had proved unwilling to grant significant economic concessions to the South. The disparity in military force structures continued to be vast and threatening. And though the global military strength of the United States remained shackled, and also declined relative to that of

the Soviet Union, it persisted in its attempts to counter Soviet influence in the Third World. American attempts to raise universal issues with reference to human rights, control over the arms trade, and the proliferation of nuclear weapons were regarded by most Third World nations as irrelevant or inimical to their aspirations.

Why had the South failed to achieve more decisive advances in line with its collective demands on the North? This question is important in view of the purpose of this paper because it touches critically on the ultimate question of whether the postulated spread of nuclear armaments in the Third World is apt to make a difference in the North-South confrontation.

The general answer to the preliminary question is obvious and banal. The weak always tend to find it hard to wrest significant changes in the status quo from the strong. Caught in this situation of inferiority, the South, during the 1970s, nevertheless had appreciable assets on which it could draw in addressing the North.

(1) There were plenty of forums, especially those provided in the complex structure of the UN, in which the South could voice its demands, and it could marshal huge voting majorities in those forums according equal votes to member states. At the very least, these displays had considerable nuisance value vis-a-vis the Northern countries.

(2) The OPEC countries had secured sufficient command over financial resources, as well as economic leverage, over the oil-importing nations of the North to have their wishes taken seriously by the latter.

(3) For a variety of reasons, after the 1950s the industrial states of the West no longer enjoyed the influence in the Third World they had easily derived from greatly superior military strength before World War II. The larger European states and Japan ceased to be significant world military powers, and the utility of force as a basis for dominating the behavior of Third World states had suffered a perceptible decline even in the case of the superpowers. Cheap gains were no longer obtainable from the application of force.

(4) The LDCs were able to withhold cooperation on issues—such as problems of environmental protection, the laws of the sea, and the prevention of nuclear proliferation—that mattered to the North.

(5) The ability of the Third World to play off the Second against the First World—which was one reason for the improved security from the superior military strength of the superpowers—was also useful in confronting the industrial capitalist

nations ideologically and politically. The Third World could usually count on the backing of the Communist states, especially the Soviet Union and China.

(6) Among significant elite groups in the capitalist North, especially those in government bureaucracies, news media, and the universities, there was growing concern with the economic plight of the LDCs and a normative identification with their cause. In the 1970s, this sympathy—more developed in some countries (e.g., the Scandinavian countries, the Netherlands and England) than in others (e.g., the United States and West Germany)—was perhaps the most important base of influence enjoyed by the South. It produced a potential readiness to bargain seriously and to compromise.

(7) Partly as a result of the development mentioned under (6), the countries of the North became less united in facing Southern demands. On the other hand, the South as a whole remained remarkably unified, particularly with reference to demands for a new international economic order.

However, while the South was able to muster enough influence to be listened to by the governments of the North, it evidently was not enough to be translated into the kind of change in international order and relations on which LDC elites had set their minds. The North was able to stall, and the South remained correspondingly frustrated. By the late 1970s it appeared that meaningful progress toward the South's objectives would depend primarily on a further strengthening of Northern sympathies with the misery of backward countries and with the normative challenge of the South, abetted perhaps by Northern considerations that the prosperity of the Third World had become a condition for a resumption of their own economic growth. The importance of the other assets that the LDCs could bring to bear in their struggle for a new international deal had waned. In fact, there were signs that the solidarity of the South was under increasing strain. The problem of Southern cohesiveness in putting pressure on the North is of interest because it is likely to affect our speculations about North-South relations in the early 1990s.

Throughout the 1960s and the first half of the 1970s, leaders and elites in the Third World had been keenly aware that cohesion in confronting the capitalist powers was a crucial precondition of eventual success. Because the Third World is, despite certain common experiences, very heterogeneous in political, economic, and cultural respects, solidarity vis-a-vis the North would not be easy to maintain. In order to fashion and preserve unity, Third World leaders formulated demands against the North that encompassed all proposals for change, including the most extreme. To present the North with a program responsive to the most moderate, as well as the most malcontent, of LDCs was no problem as long as the voicing of demands exhausted

itself on the rhetorical level; that is, as long as the North was unprepared to negotiate in earnest. Any serious bargaining was likely to reveal differences of national interest among the LDCs. The OPEC states and some other LDCs (e.g., Brazil, South Korea, Singapore) were doing economically so well in the existing economic system that they might be satisfied with relatively moderate reforms, while other countries of the South (e.g., India, Pakistan, Egypt, Zambia, Peru) remained more or less mired in economic backwardness and, especially in view of heavy population growth, achieved unsatisfactory rates of economic development. Third World states also exhibited an only partly overlapping division between countries that were radical with reference to demands on the North (e.g., Algeria, Libya, Iraq and Nigeria) and others whose expectations were comparatively moderate (e.g., Brazil, Morocco, Saudi Arabia and Malaysia). These divisions were significant enough to make the future solidarity of the South problematic.

III. NORTH-SOUTH RELATIONS IN THE EARLY 1990s

A. The Demands of the South

The topic assigned to this paper assumes that, more than a decade later, the demands of the Third World as a group on the North remain unappeased. This might happen either because concessions by the industrial North were insufficient to meet the original demands of the South or because the South had raised new demands for redistributive action designed to benefit its economic development, welfare, and autonomy. Two alternative subsidiary assumptions seem possible at this time.

Assumption A: The relevant situation in the early 1990s is essentially what it was in the middle 1970s. The bases of Third World influence did not appreciate during the intervening years. The nations of the North were willing and able to resist the major demands of the LDCs and made only gradual and insignificant concessions on economic matters. The division of the Third World between economically successful and unsuccessful states, and between countries favoring a radical or moderate challenge of the North, changed very little, as did the identity of states in each category. It can be assumed under this alternative that the economically well-off and moderate states had become even more inclined to pay little more than lip service to the challenge of the South and that some of them (e.g., Iran and Saudi Arabia) continued to require American backing for military security, while others (e.g., Ethiopia, India and Iraq) leaned on the Soviet Union in this respect. The radical members of the Third World had become increasingly embittered by the Northern refusal to satisfy their demands.

Assumption B: While the North had made some significant concessions in modifying the international economic order, the Third World is now agitating not

only for Northern adoption of the remaining original proposals, but also is making further redistributive claims involving market access; involving food, technology, and capital transfer; and—on the grounds that capitalist populations are occupying a grossly unfair proportion of land—involving an opening of Northern territories to immigration from the South. At the same time, a number of rich and successful countries of the Third World had defected from the ranks confronting the industrial North and had associated themselves with the existing political and economic order. The large majority of malcontent LDCs, however, had become more radical and cohesive in confronting the capitalist North and were strongly backed by the main Communist powers in terms of propaganda, diplomacy, and threats against any attempts by the North to intervene militarily in the Third World. Moreover, some countries of the South that had become enriched and/or were conservative in their expectations of Northern concessions during the 1970s had, by the early 1990s, become radicalized as a result of internal revolutionary coup d'etats. This could have happened to Iran, Saudi Arabia, Egypt, and others.

The new radical coalition would, in principle, oppose any great-power military intervention in the Third World, especially interventions motivated by great-power competition for influence globally and in particular regions, or military intervention in response to the request of a distressed government in the South and attracted fairly widespread tolerance or approval in the Third World. But this opposition would be more intense in the case of the United States than in the case of the Communist great powers. We may indeed assume that this Third World sensitivity had been a factor in the failure of the North to stem the proliferation of nuclear-weapons states. The spread of such arms to the South may well have been perceived by Third World leaders and elites as a development that would reduce the military superiority of the superpowers or, if technically not quite that, to diminish the utility of Northern military superiority.

The task set for this paper also assumes that there has been little change in the strategic relationship between the United States and the Soviet Union. It follows that there has also been little change in East-West relations in general, that a basic hostility or wariness persists despite limited cooperation. Even if the South remains more apprehensive of American than of Soviet military intervention on behalf of self-serving goals, the USSR is part of the relevant "North" when it comes to Southern insistence on freedom from imperialist or neo-colonialist exploitation of Northern military superiority. This imbalance of suspicion could change if the United States abstained from any such moves over an appreciable period of time while the Soviet Union continued to exercise its growing interventionary capabilities under circumstances that generated suspicions about its motives. On the other hand, there is little chance, during the envisioned time span, that the Soviets would also figure significantly in Southern economic demands. The Soviet share in international trade and world

monetary affairs will remain too small to permit an appreciable impact on the international economic order. It can be taken for granted, however, that the Soviets—in any case dedicated to the downfall of the capitalist order—will continue to support the economic demands of the South against the capitalist North. The PRC can be assumed to do the same thing even if the Soviet-China split persists unabated.

B. The Military Significance of the Spread of Nuclear Arms

We assume that, by the early 1990s, a substantial amount of nuclear weapons proliferation has taken place in the Third World and that the current and presumably continuing transfer of various arms technologies from the North to the South permits the acquisition of delivery systems which, even if far from comparable to those deployed by the superpowers in accuracy, reliability, and range (let alone varieties and numbers), makes them technically usable in local and regional conflicts between Third World countries. We assume, furthermore, that their actual use—on which threat-making depends—against states of the North cannot be excluded *on technical grounds*. Depending on precise geographic circumstances, delivery would certainly not be prohibited by limitations of range against territories, extra-territorial military bases, and force concentration (e.g., naval) of industrial states that are within regional confines. And even though the range of usability would tend to decrease over larger distances, inter-regional delivery by long-range aircraft or surreptitiously by surface ship, or in other ways, cannot be ruled out on technical grounds.

These technical possibilities, however, do not ensure a military capability for issuing credible nuclear threats against the North. The two superpowers may well possess offensive capabilities permitting preemptive disarming strikes against LDC forces, and defenses that make effective penetration of their homelands extremely difficult and unlikely. Even if they could not hope to be completely invulnerable to considerable local damage, they would be able to devastate an attacking LDC in a retaliatory blow. The expected imbalance of destruction would serve to deter any rational decisionmaker in the South from initiating nuclear war against a superpower. This means that nuclear Third World states would remain without any power of *compellence*. They could not make a superpower do anything positive by threatening a nuclear exchange. Threats of nuclear *deterrence*, however,—that is, the ability to restrain a great power from committing a hostile act—would be somewhat less incredible. Nor can completely rational decisions be counted upon. There are degrees of rationality and irrationality in the real world. To be sure, an LDC under superpower attack, even a conventional attack, would still face the prospect of a disproportionately damaging counter-attack if it resorted to a nuclear strike against the homeland of the superpower, or even against superpower bases and force concentrations in the region. But the government of the superpower could not be sure

that a desperate LDC leader might not make the "irrational" decision to hit back. And a rational response to this cautioning uncertainty would have a degree of deterrent value. Moreover, even if a nuclear LDC threat against states of the North that are lesser nuclear powers or lack nuclear forces would not be regarded as credible, absolutely speaking, it would be less incredible than that against a superpower unless such Northern countries were definitely known to enjoy complete backing by one of the superpowers.

There is one more potential nuclear threat that the North may face from the South. This would emanate not from LDC government actions but from terrorist champions of the South's revolt against the industrial North. Nuclear weapons proliferation in the Third World—where domestic rule is often feeble and politics turbulent, where government efficiency tends to be low and resources allocated to the safeguarding of nuclear arms may be inadequate, and where internationally active terrorists have attracted considerable support in the form of money, training, and supplies—can be assumed to increase opportunities for terrorists to steal or otherwise acquire nuclear weapons (possibly with the connivance of a government). The Third World also develops readily the human material for the recruitment of activists who are intensely dedicated to political causes and believe the fight for justice, as perceived by them, to legitimize the infliction of terror. It is not inconceivable, therefore, that such partisans will be prepared in the future to resort to nuclear threats in order to coerce the North into sweeping concessions to the demands of the South.

It may not be likely that such a threat will arise; but, if it does—and the possibility cannot be excluded—the terrorist threat could be more serious than the nuclear threat emanating from any LDC government which has come into possession of nuclear armaments. This would be so because defense against small and anonymous terrorist groups is difficult and, above all, because they do not offer a target for a deterring retaliatory nuclear threat.

The extent, even though estimated as small, to which nuclear-weapons states of the South may present a military problem to the North depends on whether the LDCs involved will be conservative or radical in their attitudes toward the industrial states. It is generally thought that the decisions to go for nuclear arms will be determined primarily by local and regional security needs or military ambitions, and this incentive is apt to operate with either set of LDCs, although in conservative countries, the strength of this incentive will be affected by the confidence they derive from any security arrangements with Northern powers, especially the United States, and, in this case, also the USSR. In addition to incentive, proliferation depends, of course, on possession of a suitable technological and military infrastructure. This endowment will have been developed for the most part by the larger OPEC states and by other LDCs

that have experienced rapid industrialization and large imports of modern military equipment from the North, including the Soviet Union. During the 1970s, many of these states (e.g., Saudi Arabia, Iran, Egypt, South Korea, Taiwan, Brazil) were moderate in their demands on the North. But some of them were not (e.g., Algeria, Libya, Iraq, Nigeria) and—on our alternative Assumption B—some of the moderates could turn radical by the early 1990s.

C. Military and Political Implications for North-South Relations

The foregoing analysis suggests that for three reasons the further spread of nuclear weaponry to the Third World will bring changes in international relations that are in line with the demands of the South on the North.

First, the potential terrorist threat aside, while the homelands of the North would hardly be subject to considerable military threats from nuclear arms in the Third World, uncertainties about the possibility of irrational and uncontrolled behavior in a crisis would render the North less inviolate than before, and the nations of the North would presumably be correspondingly more circumspect than they have been in challenging states of the South.

Second, these uncertainties would probably be more compelling in the event an industrial power intervened militarily in the world of the South. In particular, the possibility of nuclear reprisals by LDCs against Northern military bases and force concentrations in the area of conflict would make intervention somewhat more risky. One would expect as a result that intervention by force would become less likely simply because the Third World has become militarily more prickly. It is possible, furthermore, that the specter of nuclear terrorism would reinforce this disincentive. This constraint would not, of course, be absolute. But the values at stake in any conflict in the Third World would have to be correspondingly higher before the option to intervene would be regarded as suitable in the pursuit of national interests.

Third, it is likely under these circumstances that the great powers of the North would curtail alliance and patron-client commitments that entangle them in the disputes of a Third World that, after proliferation, has become more dangerous to operate in. This is not to say that such commitments may not be maintained in areas, particularly those contiguous to the territory of Northern states, where control remains desirable for bolstering the security of Northern homelands. Globally, however, superpower disposition to seek and preserve commitments designed to curb the influence of rivals could be expected to wane.

According to this assessment, the spread of nuclear weapons to the South would represent a further step in the diffusion of world military capabilities and in the

international patterns of influence that tend to be associated with them. Such a development would not necessarily mean that the welfare of the South would, in the net, be enhanced, for nuclear proliferation has also the potential of great destructiveness in South interrelationships. Yet the autonomy of the Third World vis-a-vis forceful interference from the North would stand to gain and this, as we have noted, is a major objective of the LDC world. Even if a substantial spread of nuclear arms, constituting new security problems for all states—South and North—evoked widespread desires for arms controls designed to diminish this new insecurity—a desire that might be evinced in the South as well as in the North—Third World states could now insist that they be treated as equals in these matters, and it would be surprising if the North would not heed this demand.

D. Implications Regarding Demands for NIEO

No matter how alienated the Third World might be from the existing international economic order, the spread of nuclear arms to countries of the South will have no direct effects on improving their bargaining position in pressing for redistributional changes. The use of nuclear threats on behalf of these goals would require power of compellence rather than of deterrence, and such power, as we have shown above, cannot be derived from the possession of nuclear capabilities, dwarfed by those of the North, as long as reasonably rational decision-making prevails. Suicidal bluffing would have no credibility in this context. No coalition, even of radical LDCs, could be formed for this purpose since it would presuppose grossly irrational governments in all participating states. The value of any economic gains that could be expected for the Third World as a whole would be disproportionately insufficient to justify the assumption of suicidal risks. Even a nuclear threat by one "mad" ruler would be extremely unlikely because successful blackmail would be so obviously improbable and because any NIEO gains accruing specifically to any one LDC would be uncertain and undramatic.

It is even possible that nuclear proliferation in the South would weaken the NIEO cause in one respect. As we have seen, LDC unity on NIEO is not basically as solid as it has been on the rhetorical level; and nuclear spread could have consequences apt to undermine this solidarity, certainly under Assumption A but conceivably also under Assumption B. Nobody can safely predict what the acquisition of nuclear weapons would do to Third World stability and cohesion. That world is full of acute and dormant disputes and tensions. It could nevertheless happen, at least in some areas, that a combination of favorable circumstances would result in stable situations of deterrence. It is also true that, in the past, the maintenance of a common front against the North proved possible among unfriendly members. At the present time, although Morocco and Algeria, Libya and Egypt, Syria and Iraq regard one another with considerable animosity, they remain effective members of the Group of 77. Yet an

increase in mutual fears and hostility could not help but diminish effective unity of purpose, and the spread of nuclear weapons would probably lead to this condition. It is hard to see that nuclear proliferation would reproduce generally in the Third World the degree of strategic stability which evolved in East-West relationships because situations of mutually assured destruction would be hard to replicate in many parts of the Third World. And if the cohesion of the South were to suffer as a result, which is far from impossible, the South's ability to challenge the North on NIEO would decline. Indeed, under worst assumptions of frequent military crises and perhaps catastrophic encounters in the Third World, and resultant chaos, that challenge would probably disintegrate.

Yet there are also possible *indirect* effects of nuclear spread that could be expected to help the economic cause of the South, provided Third World chaos is avoided. First, the emergence of a nuclear terrorist threat in support of NIEO goals would surely trouble authorities in the highly industrialized states, and make them more cautious in dealing with the South. Second, if they felt desperate enough on this issue, LDCs might decide to make all kinds of mischief, for example by putting disruptive economic pressures on the North, especially by utilizing whatever leverage is afforded by the control over oil exports and prices and, perhaps, over some other supplies of raw materials as well. This sort of action might not be very likely since, to adopt it, would be economically costly to the LDCs involved. But if they felt driven to such steps, they would not have to fear, under conditions of nuclear spread, that Northern states would be likely to respond by military reprisals.

Third, the states of the South might exploit any surge in Northern desires for global arrangements of arms control by making cooperation contingent on substantial NIEO concessions. Fourth, and probably most important, with the spread of nuclear armaments to the South under likely conditions of great turbulence in the Third World, and hence, with the enhanced prospect of nuclear war somewhere breaking out sooner or later, appalled Northern nations would probably experience a heightened sense of diffuse insecurity and perceive more sharply than before that, in a highly interdependent world, the large majority of the world's states and population could not safely be treated with benign—or not so benign—neglect, and that no reasonably tolerable approximation of world order would be feasible without far-reaching global consensus, including the consent of the Third World. Such troubled perceptions might well induce Northern governments to do all they could to promote stability in the South, and agreeing to serious negotiations on NIEO and salient concessions to the demands of the South, might well come to be regarded as an essential part of such an endeavor at global pacification. This is not, of course, a necessary response. The industrial powers of the North might instead prefer to seal themselves off, as best they could, from a disorderly and troublesome South. But it is extremely doubtful that the South could be placed in effective quarantine and that

isolation would work. Northern leaders would probably soon understand this. To foster and support, as much as possible in view of Northern domestic constraints, a global climate of restraint and moderation would probably seem to be the better bet. And such a course of action would argue for conciliatory and constructive measures in meeting the demands of the Third World for economic equity.

To conclude: The many LDCs that only recently emerged from colonial bondage, the achievement of formal national sovereignty has indubitably entailed benefits to the vast majority in terms of political and economic autonomy, and probably also in terms of economic welfare. It is our estimate that, in various ways, the strengthening of LDC military sovereignty, and the consequent diffusion of military capacity that would be increased by the spread of nuclear weapons, would probably benefit the South further in its political, military, and economic relations with the North.

IV. POSTSCRIPT

There is, of course, no way in which we can predict with confidence what the consequences of further proliferation of nuclear armaments will engender. All that we can do is to conjecture. Yet such estimates are very sensitive to the contingent hypotheses that are brought into play. The problem that was posed for this paper made the implicit assumption that, other than the spread of nuclear weapons to countries of the South, international relationships—and the national conditions on which these rest—will remain roughly the same by the early 1990s as they are now. This assumption is justified by compelling analytical concentration on the impact of one particular change in parameters. But it is clearly possible, and perhaps likely, that other major changes will have occurred as well and that alternative assumptions about these might affect the ways in which nuclear proliferation will impinge on North-South relations.

There is no room in this paper for extending the analysis in alternative directions. But it seems apposite at least to mention two other possible and rather extreme changes that would suggest different conjectures. First, by the early 1990s, the great Communist powers might dominate the capitalist West because the strategic nuclear balance between East and West has been upset in their favor, and/or because the Soviet-Chinese split has been repaired (if only in part and temporarily), and/or because the capitalist West has been profoundly weakened by the persistence of economic stagflation and its domestic political consequences. At the same time, the great Communist powers in cooperation with allied LDCs (e.g., Cuba) have also achieved substantial dominance over large parts of the Third World. NIEO demands on the West, now encompassing elements of Southern and Second World objectives, could then be backed by fairly effective coercive pressures, although hardly nuclear threats. Second, it is also conceivable that, by the early 1990s, the Soviet Union has

fallen prey to profound and semi-paralyzing domestic crisis, that Soviet-Chinese antagonism has become more severe, that the United States has recovered its international composure, that a resumption of steady world economic growth has induced a number of prospering LDCs to join the North, and that—as a joint result—the confrontational demands of South on North have become less effectual.